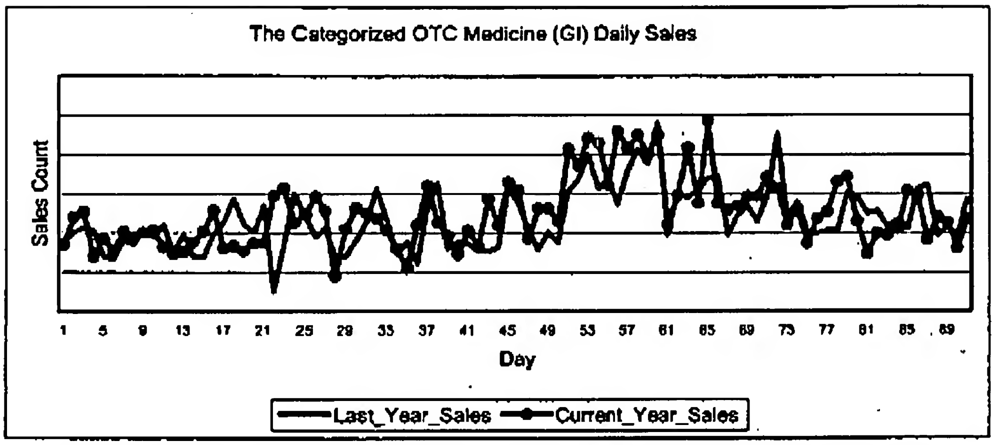

Figure 1.The OTC daily sales in this year and last year in the study area

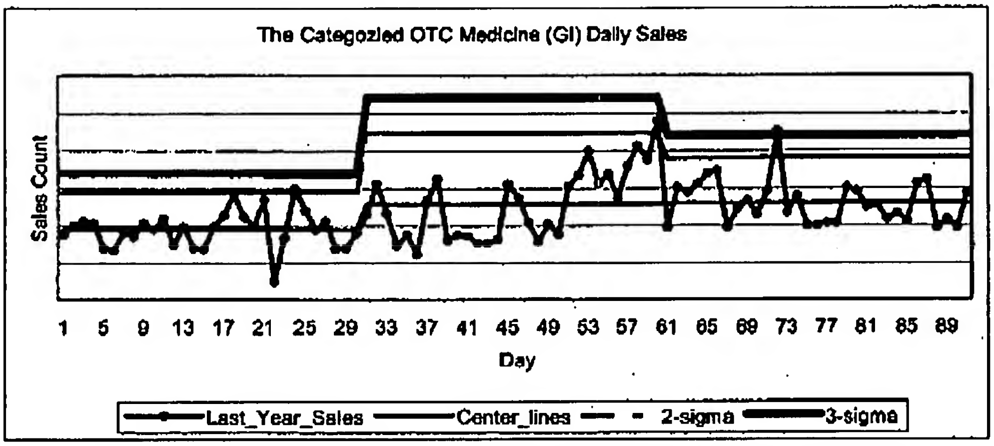

Figure 2.The derived reference lines from the last year's daily sales

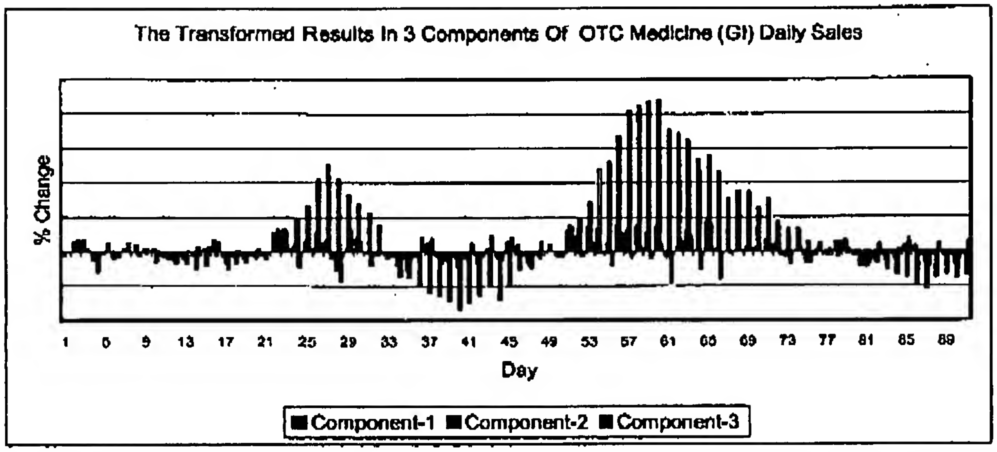

Figure 3.The transformed incoming daily sales in 3 components by Eq. (4), (5) and (6)

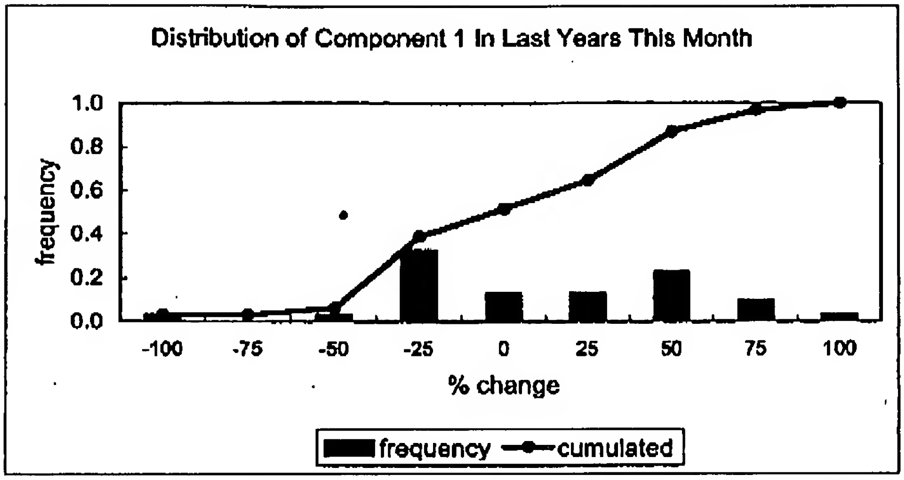

Figure 4.Deriving threshold value from the distribution of Component 1

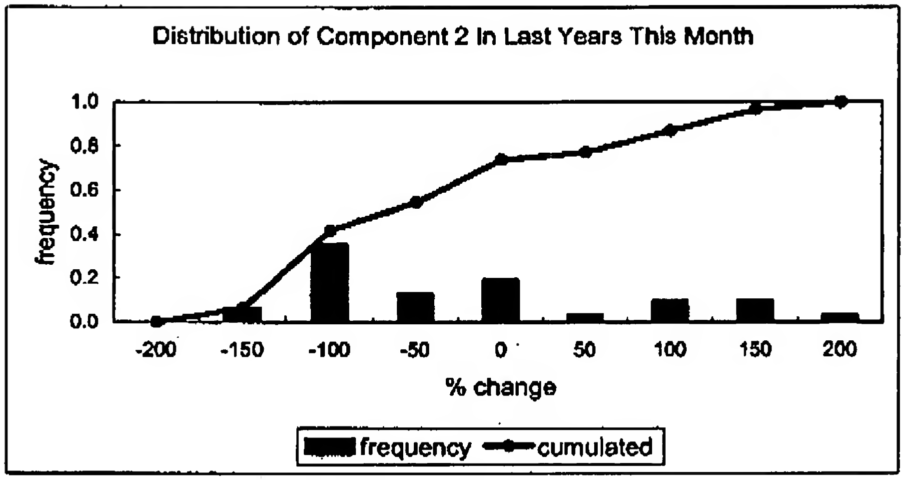

Figure 5. Deriving threshold value from the distribution of the component 2

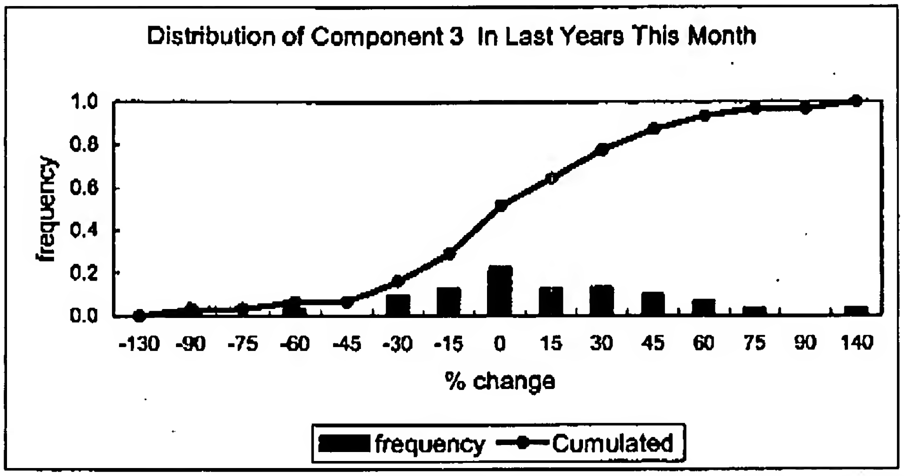

Figure 6. Deriving threshold value from the distribution of the component 3

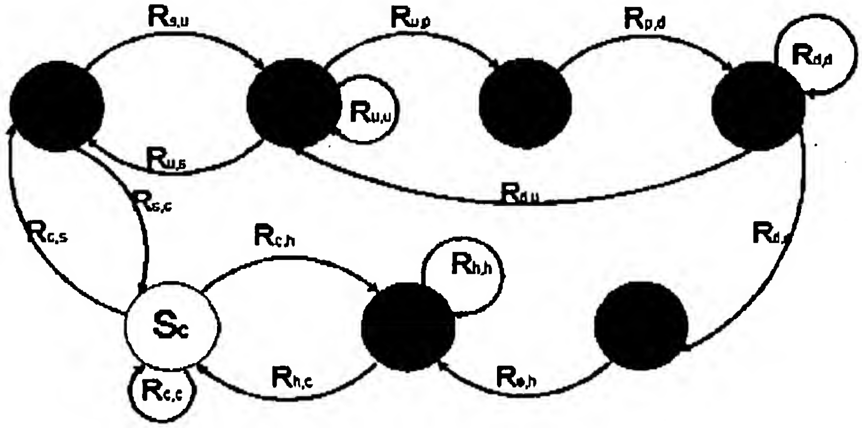

Figure 7.The States and State Transition Diagram of Public Health Status

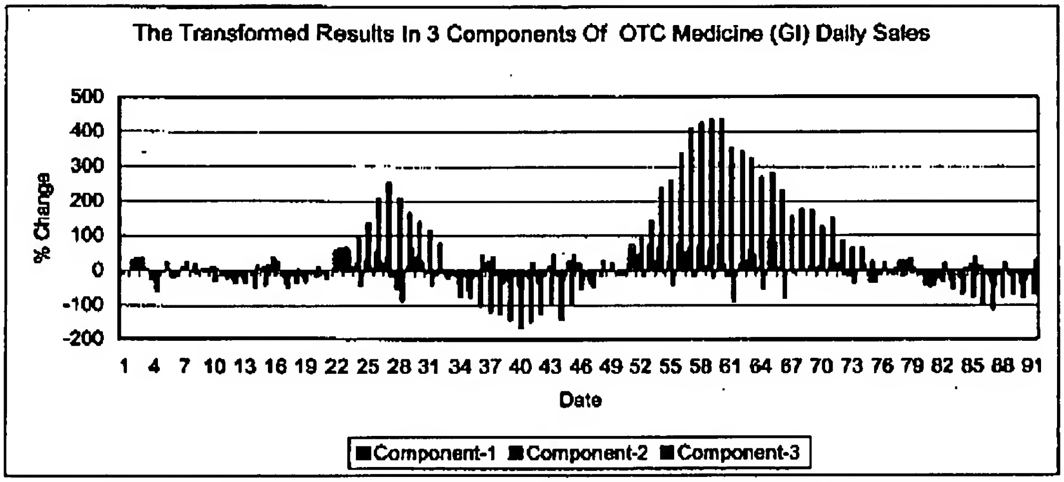

Figure 8.The example of transformed results of OTC daily sales data

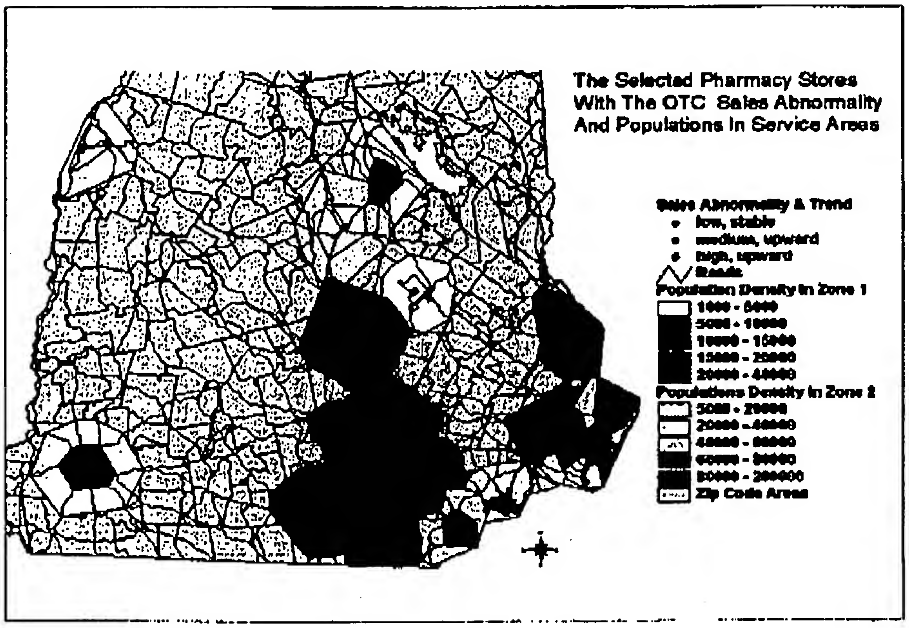

Figure 9. An example of the categorized OTC sales abnormality analysis with population density in service area as the potential impact

Table 1. The validated state transitions from a State Si(k) to State Sj(k+1)

	$R_{h,h}$	$R_{h,c}$	0	0	0	0	0
	$R_{c,h}$	$R_{c,c}$	$R_{c,s}$	0	0	0	0
	0	$R_{s,c}$	0	$R_{s,u}$	0	0	0
	0	0	$R_{u,s}$	$R_{u,u}$	$R_{u,p}$	0	0
	0	0	0	0	0	$R_{p,d}$	0
	0	0	0	$R_{d,u}$	0	$R_{d,d}$	$R_{d,e}$
	$R_{e,h}$	0	0	0	0	0	0

Equation (1), (2) and (3):

If,

- *l* denotes the year
- L is the current year
- *m* is the number of years with historical data available
- *i* denotes the day of the month
- *j* is the month of a year. (an exemplary time unit used for simplified demonstration purposes only)

Thus, *$i \in [1,31]$, $j \in [1,12]$, l and m are integers.*

$$\bar{x}_j = \frac{1}{m x n} \sum_{l=L-1}^{L-m} \sum_{i=1}^{n} x_{l,j,i} \qquad (where\ i \in [1,31]\ and\ j \in [1,12]) \qquad (1)$$

$$s_j = \frac{1}{(m x n - 1)} \sqrt{\sum_{l=L-1}^{L-m} \sum_{i=1}^{n} (x_{l,j,i} - \bar{x}_j)^2} \qquad (where\ i \in [1,31]\ and\ j \in [1,12]) \qquad (2)$$

$$C_j = \bar{x}_j + t_{m x n - 1}\, s_j \qquad (where\ i \in [1,31]\ and\ j \in [1,12]) \qquad (3)$$

Equation (4), (5) and (6):

$$d_{L,j,i} = \frac{x_{L,j,i} - \bar{x}_j}{\bar{x}_j} \text{x} 100 \qquad (L - year, j - month, i - day of month) \qquad (4)$$

$$w_{L,j,i} = \sum_{n=0}^{n=6} d_{L,j,i-n} \qquad (7 - days\ cumulated\ deviation) \qquad (5)$$

$$v_{L,j,i} = d_{L,j,i} - d_{L,j,i-1} \qquad (change\ of\ the\ daily\ deviation) \qquad (6)$$

Equation (7), (8) and (9):

$$\mathrm{supp}(\alpha(k)) = \{d_{l<L,J,j};\ F(d) \geq (1-\alpha)\} \qquad (7)$$

$$\mathrm{supp}(\beta(k)) = \{w_{l<L,J,j};\ F(w) \geq (1-\beta)\} \qquad (8)$$

$$\mathrm{supp}(\delta(k)) = \{v_{l<L,J,j};\ F(v) \geq (1-\delta)\} \qquad (9)$$

Equation (10), (11), (12), (13), (14) and (15):

$$S_j(k+1) \Leftarrow \{S_i(k) \otimes R_{i,j} \otimes X_i(k),\ S_i(k) = k_w w_i(k)\} \qquad (10)$$

$$X_i(k) \Leftarrow B_{i,m}(\alpha(k), \beta(k), \delta(k)) \otimes \begin{bmatrix} d_{i,m}(k) \\ w_{i,m}(k) \\ v_{i,m}(k) \end{bmatrix} \qquad (11)$$

$$Y_i(k) \Leftarrow H_{i,n}\{(\gamma_0(k), \gamma_1(k), \ldots, \gamma_n(k)) \otimes \begin{bmatrix} S(k) \\ S(k-1) \\ \ldots \\ S(k-n) \end{bmatrix} \otimes G_i(k)\} \qquad (12)$$

where

$$X \subset \bigcup_{z=1}^{Z} \mathrm{supp}\,(z) \qquad (13)$$

$$\mathrm{supp}(z) = \mathrm{supp}(X_{z,1}) \times \mathrm{supp}(X_{z,2}) \times \mathrm{supp}(X_{z,3}) \qquad (14)$$

$$Y_i = (Q_{i,h}, T_{i,h}, P_{i,h}) \qquad (15)$$